WHAT IS CLAIMED IS:

sub A1

1. An optical amplifier for amplifying, at once, multiplexed signal light belonging to a predetermined wavelength band, in which a plurality of signal light components having different wavelengths are multiplexed, comprising:

one or a plurality of optical amplification sections each of which has an optical waveguide doped with a fluorescent material and amplifies the multiplexed signal light by optical pumping of the fluorescent material;

an optical pumping light source for supplying predetermined optical pumping light to said optical amplification section;

an optical filter capable of changing a gradient $dL/d\lambda$ of a loss L (dB) with respect to a wavelength λ (nm) in the predetermined wavelength band; and

control means for controlling an optical pumping light output from said optical pumping light source such that light power after amplification has a predetermined target value, and for adjusting a characteristic of said optical filter to adjust a final gain characteristic.

2. An amplifier according to claim 1, wherein said optical filter satisfies

$$L \approx a(\lambda - \lambda c) + b$$

(where λc (nm) and *b* (dB) are constants) in the predetermined wavelength band and changes *a* (dB/nm) to adjust the gradient $dL/d\lambda$.

3. An amplifier according to claim 1, further comprising a gain equalizer for compensating for an inherent wavelength-dependent gain of said optical amplification section.

4. An amplifier according to claim 1, further comprising a wave number monitor for detecting the number of signal light components contained in the multiplexed signal light, and wherein said control means adjusts the target value of light power after amplification in accordance with the number of signal light components detected by said wave number monitor.

5. An amplifier according to claim 1, further comprising input light power detection means for detecting the light power input to said optical amplification section, and wherein said control means adjusts the gradient $dL/d\lambda$ of said optical filter on the basis of the detection result by said input light power detection means.

6. An amplifier according to claim 1, further comprising gain detection means for detecting a gain of said optical amplification section, and wherein said control means adjusts the gradient $dL/d\lambda$ of said optical filter on the basis of the detection result by

said gain detection means.

7. An amplifier according to claim 1, further comprising detection means for detecting each wavelength and power of signal light components contained in the light output from said optical amplification section, and wherein said control means adjusts the gradient dL/dλ of said optical filter on the basis of power deviation between two signal light components having shortest and longest wavelengths detected by said detection means.

8. An amplifier according to claim 7, further comprising read means for reading information related to the shortest and longest wavelengths of the signal light components in the multiplexed signal light sent together with the multiplexed signal light, and wherein said control means obtains the power deviation on the basis of the information obtained by said read means.

9. An amplifier according to claim 1, further comprising ASE light level detection means for detecting an ASE light levels of the light output from said optical amplification section at each wavelengths outside two ends of the predetermined wavelength band, and wherein said control means adjusts the gradient dL/dλ of said optical filter so that a level difference between ASE light levels detected by said ASE light level detection means becomes constant.

10. An amplifier according to claim 1, further comprising:

detection means for detecting each wavelength and power of signal light components contained in the light output from said optical amplification section; and

ASE light level detection means for detecting an ASE light levels of the light output from said optical amplification section at each wavelengths one of which is shorter than the shortest wavelength and the other of which is longer than the longest wavelength both of which detected by said detection means, and

wherein said control means adjusts the gradient dL/dλ of said optical filter so that a level difference between ASE light levels detected by said ASE light level detection means becomes constant.

11. An amplifier according to claim 10, further comprising read means for reading information related to the shortest and longest wavelengths of the signal light components in the multiplexed signal light sent together with the multiplexed signal light, and wherein said ASE light level detection means determines wavelengths to be detected on the basis of the information obtained by said read means.

12. An amplifier according to claim 2, wherein λc of said optical filter is set in the predetermined wavelength band.

13. An amplifier according to claim 1, wherein said optical filter comprises:

a main optical path which guides the multiplexed signal light and is divided into first to sixth regions sequentially from an upstream side;

a first sub optical path which is arranged close to the first and third regions of the main optical path so that optical coupling of propagation light occurs, is spaced apart from the second region of the main optical path so that optical coupling of the propagation light does not occur, and has a region corresponding to the second region of the main optical path, the region having a length different from that of the main optical path;

a second sub optical path which is arranged close to the fourth and sixth regions of the main optical path so that optical coupling of the propagation light occurs, is spaced apart from the fifth region of the main optical path so that optical coupling of the propagation light does not occur, and has a region corresponding to the fifth region of the main optical path, the region having a length different from that of the main optical path;

a first temperature adjusting device arranged in at least one of the second region of the main optical path and the region of the first sub optical path,

which corresponds to the second region of the main optical path; and

a second temperature adjusting device arranged in at least one of the fifth region of the main optical path and the region of the second sub optical path, which corresponds to the fifth region of the main optical path.

Sub A2

14. An optical amplification method of amplifying, at once, multiplexed signal light belonging to a predetermined wavelength band, in which a plurality of signal light components having different wavelengths are multiplexed, comprising the steps of:

guiding the multiplexed signal light to an optical waveguide doped with a fluorescent material together with predetermined optical pumping light and optically amplifying the multiplexed signal light;

guiding at least one of the multiplexed signal light before amplification and that after amplification to an optical filter capable of changing a gradient $dL/d\lambda$ of a loss L (dB) with respect to a wavelength λ (nm) in the predetermined wavelength band and adjusting the gradient $dL/d\lambda$ of the optical filter to reduce a wavelength-dependent gain in the optical amplification; and

adjusting an intensity of the optical pumping light to adjust light power after amplification to a

~~predetermined target value.~~

15. A method according to claim 14, wherein the optical filter satisfies

$$L \approx a(\lambda - \lambda c) + b$$

(where λc (nm) and *b* (dB) are constants) in the predetermined wavelength band and changes *a* (dB/nm) to adjust the gradient dL/dλ.

16. A method according to claim 14, further comprising the step of reducing an inherent wavelength-dependent gain in the optical amplification using a predetermined gain equalizer.

17. A method according to claim 14, further comprising the step of detecting the number of signal light components contained in the multiplexed signal light and adjusting the target value of light power after amplification in accordance with the detected number of signal light components.

18. A method according to claim 14, further comprising the step of adjusting the gradient dL/dλ of the optical filter on the basis of light power of the multiplexed signal light before the optical amplification.

19. A method according to claim 14, further comprising the step of adjusting the gradient dL/dλ of the optical filter on the basis of the gain in the optical amplification.

20. A method according to claim 14, further comprising the step of adjusting the gradient dL/dλ of the optical filter on the basis of deviation of light power between two different wavelengths detected in the predetermined wavelength band of the light after the optical amplification.

21. A method according to claim 20, further comprising the step of reading information related to shortest and longest wavelengths of the signal light components in the multiplexed signal light sent together with the multiplexed signal light, and wherein the two different wavelengths are the read shortest and longest wavelengths.

22. A method according to claim 14, further comprising detecting ASE light levels of each of wavelengths outside two ends of the predetermined wavelength band of the light after optical amplification and adjusting the gradient dL/dλ of the optical filter so that a difference between two ASE light levels becomes constant.

23. A method according to claim 14, further comprising the step of detecting each wavelength and power of signal light components contained in the light after the optical amplification and detecting ASE light levels at each wavelengths one of which is shorter than the shortest detected wavelength and the other of which

is longer than the longest detected wavelength.

24. A method according to claim 23, further comprising the step of reading information related to shortest and longest wavelengths of the signal light components in the multiplexed signal light sent together with the multiplexed signal light, and determining two wavelengths to be ASE light levels detected, on the basis of the read shortest wavelength and longest wavelength.

25. A method according to claim 14, wherein λc of the optical filter is set and adjusted in the predetermined wavelength band.

26. A method according to claim 14, further comprising when a total transmittance in the predetermined wavelength band of the optical filter is adjusted to a maximum value, adjusting the loss L to be substantially constant independently of the wavelength.

27. A method according to claim 14, wherein the optical filter comprises:

a main optical path which guides the multiplexed signal light and is divided into first to sixth regions sequentially from an upstream side;

a first sub optical path which is arranged close to the first and third regions of the main optical path so that optical coupling of propagation light occurs, is spaced apart from the second region of the main

optical path so that optical coupling of the propagation light does not occur, and has a region corresponding to the second region of the main optical path, the region having a length different from that of the main optical path;

a second sub optical path which is arranged close to the fourth and sixth regions of the main optical path so that optical coupling of the propagation light occurs, is spaced apart from the fifth region of the main optical path so that optical coupling of the propagation light does not occur, and has a region corresponding to the fifth region of the main optical path, the region having a length different from that of the main optical path, and

said adjusting the gradient dL/dλ of the optical filter is achieved by adjusting at least one of a temperature in the first sub optical path and a temperature in a region of the main optical path which corresponds to the first sub optical path, and at least one of a temperature in the second sub optical path and a temperature in a region of the main optical path which corresponds to the second sub optical path.

add A3